



# Seminar and Roundtable on Coalbed Methane Development and Potential



## CHINA

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### Current CBM Activities

- CBM Development Project in Panzhuang Mine
- Asian Development Bank (ADB) Sponsored CBM Project
- APEC Coal Mine Gas Project
- CBM Exploration and Development in the Yangquan Coal Area
- Texaco Huaibei CBM Development Project
- Xinji Coalbed Methane Project
- Arco Project
- Philips Project
- UN-GEF Development of CBM Resources
- UN Deep CBM Exploration Project

### Key Factors in Energy Economy

- China is the world's largest producer of coal, producing 1.25 billion tons in 1994.
- China is also the world's largest consumer of coal, which supplies about 75% of the country's total energy needs.

### Potential Role of CBM in Energy Economy

- More than a three-fold increase in CBM production in mine-drained CBM utilization is possible and would result in an overall volume of  $1 - 2 \times 10^9 \text{ m}^3$ . This compares with a 1990 natural gas production level of  $15 \times 10^6 \text{ m}^3$ .
- The main potential use of this mine gas is within the Coal Mining Administration (CMA) and is less likely to attract international commercial investment.
- The total CBM resource in China is  $30-35 \times 10^{12} \text{ m}^3$  to depths of 2,000m.
- Total CBM emitted is estimated at  $\sim 5 \times 10^9 \text{ m}^3$  by U.S. EPA, and  $19 \times 10^9 \text{ m}^3$  by the UNDP, and  $7.7 \times 10^9 \text{ m}^3$  by the Ministry of Coal Industry (MOCI).
- In 1996, the total CBM recovered was  $618.6 \times 10^6 \text{ m}^3$ , which was



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roughly 8% of total emissions.

### CBM Potential

The development of CBM from surface boreholes has great potential. The China United CBM Co. Ltd. has set targets for CBM production in China from surface boreholes of  $1 \times 10^9$  m<sup>3</sup>/year by the year 2000 and  $10 \times 10^9$  m<sup>3</sup>/year by 2010.

### Existing Policies Affecting CBM Development

- China Agenda 21 – White Paper on China's Population, Environment and Development for the 21st Century: Is relevant to CBM development in that it: 1) promotes an increase in CBM development and utilization; 2) suggests providing incentives to support development of clean energy resources (including CBM); and 3) directs the Chinese energy industry to “develop and utilize coalbed methane resource[s], strengthen coalbed methane resource evaluation, and introduce underground or surface recovery and utilization technologies to control greenhouse gas emissions from coal mines to the atmosphere”
- The Mineral Resources Law (1986): Encourages additional foreign investment by providing a comprehensive legal framework for coal exploration and exploitation.
- Provisional Regulation and Rules for the Management of Exploration and Development of Coalbed Methane (1994): Promotes the “... rational development and utilization of coalbed methane resources, strengthening the management of exploration and development of coalbed methane resources and ensuring that the exploration, planning, design and mining operation of coal resources will not be affected by the exploration and development of the coalbed methane.”
- The Reform Agenda (1997) Restructure State Enterprises: Speeds up a program to convert state enterprises, which account for a third



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of industrial output, into corporations owned by stockholders.

Government ownership could even be reduced to minority stakes.

- Sell State Assets: Allow government bodies to sell off all but 1,000 of China's 305,000 state enterprises. Companies that can't be sold will go bankrupt.

### Overseeing or Permitting Government Agencies

- State Council
- China United Coalbed Methane Corporation Limited
- State Development Planning Commission
- Ministry of Land and Natural Resources (former Ministry of Geology and Mineral Resources)
- State Coal Industry Bureau (former Ministry of Coal Industry)
- China National Petroleum Corporation
- Ministry of Foreign Trade and Economic Cooperation

### Potential Barriers to CBM Development

- Lack of technology
- CBM mine safety is the principle business concern
- Lack of infrastructure
- Lack of awareness of environmental issues
- Lack of funds for investment in CBM

### Donors/ Companies/ Investors Active in CBM

World Bank, U.S. Environmental Protection Agency, Asian Development Bank, UNDP, UNEP, Texaco, ARCO, Phillips, Amoco, Enron, Sino-American Energy Co., Lowell Petroleum Co., BHP, AMT Drilling Co., State Development Planning Commission, Ministry of Science and Technology, State Development Bank, State Coal Industry Bureau, Ministry of Land and Natural Resources, China National Petroleum Corporation, China United Coalbed Methane Corporation Limited, Zhongyuan Oilfield, Huabei Oilfield, Northern China Bureau of



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Petroleum Geology, Jindan Energy Research and Development Co.,  
Yanquan Coalbed Methane Development Co., Huawell Petroleum,  
Central Coal Research Institute Xi-an Branch, Star Mining Corp.



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**CBM Development Project in Panzhuang Mine**

**Contact Information**

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**Status**

Operational

**Location**

Panzhuang Mine, Jincheng CMA

**Technical Summary**

The project started in 1994 as a joint undertaking between Jincheng CMA and the American partner Sino-American Energy Co. Ltd. in equal partnership. So far, 7 surface wells have been drilled and all have undergone fracturing. Of the 7 wells, 4 are in stable production with single well peak production exceeding 10,000 m<sup>3</sup>/d. Water discharge for gas production for the latter 3 wells is underway with gas production ranges of 500-1800 m<sup>3</sup>/d. Gas produced is being used for power generation and a small 2X120 kW power plant is operational. Further 4X220 kW units have been ordered and will be put into operation shortly.

**Estimated Capital  
and O&M Costs**

Cost of a production well is ~\$310,000 (1\$US to 8.3 yuan) including and O&M costs. The partners equally contributed investment for the



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project in Panzhuang Mine. The Shanxi provincial government provided an initial loan of US\$1,205,000.

## Sources of Revenue

CBM produced will be used for power generation for on-site use resulting in savings in electricity purchasing costs.

## Proponents/ Sponsors of the Project

- Jincheng CIVIA & Sino-American Energy Co. Ltd.
- Jin An'xin
- Shanxi-Jindan Energy Research & Development Co. Ltd.

## Lessons Learned

CBM development using surface wells has to be adapted according to site-specific conditions. American experience cannot be copied into China without being adapted. For example, initial production from the No. 2 well reached more than 10,000 m<sup>3</sup>/d but was not sustainable at this level. By using a high pumping rate, as was requested by the American partner, the well became clogged with sand and fine coal. In another case, the No. 3 well initially had a packer installed to block water coming from underneath the target seam. Stable gas production was recorded at more than 12,000 m<sup>3</sup>/d. When the packer was removed, the water level increased, dramatically stopping gas production. The water problem persisted for a considerable period of time. In later wells, pumping was maintained at an appropriate rate, and stable gas production of ~5,000 m<sup>3</sup>/d was achieved for more than a year.



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**Asian Development Bank (ADB) Sponsored CBM Project**

**Contact Information**

Wang Qinghua  
Department of International Cooperation  
State Coal Industry Bureau  
21 Hepinli Beijie, Beijing 100713  
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**Status**

On-going

**Location**

Yangquan CMA, Yangquan City, Shanxi Province

**Technical Summary**

The project has three phases:

- Phase 1. Survey of CBM resources, development status, and policy and legal framework governing CBM development; project inventory and target area selection; and determination of a specific integrated CBM development and utilization project. The first phase of the project was conducted early in 1998 and completed in May 1998.
- Phase 2. Feasibility study for a CBM-fired power plant in Yangquan CMA, Shanxi Province. Initiation of the 2nd phase is set for October 1998 and will be completed in ~6 months.
- Phase 3. Detailed engineering design, construction, and commissioning of the power plant. Phase 1 was initiated in 1998 and completed in May of that year. Phase 2 is scheduled for October 1998 and will be completed in ~six months. Phase 3 will depend on the results of the feasibility study.



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## **Estimated Capital and O&M Costs**

ADB provided a US\$700,000 technical assistance fund for the 1st and 2nd phases of the project. ADB will provide a loan of approximately US\$50~100 million to complete the 3rd phase.

## **Sources of Revenue**

Power generated using CBM drained from underground mines in Yangquan will be used on-site for mine production. This will reduce electricity purchasing costs.

## **Proponents/ Sponsors of the Project**

Asian Development Bank  
Edu Hassing, Senior Project Officer  
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0401 MM, P.O. Box 789, 0980 Manila, Philippines  
Phone: +632 632 6385  
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**APEC Coal Mine Gas Project**

**Contact Information**

Yang Shi'an  
Tiefu Coal Mining Administration, Liaoning Province  
Phone: +86 410 6822502  
Fax: +86 410 66865601

**Status**

On-going: The project is divided into three phases:

- Phase 1 (1996-97) - Site Study in China and selection of project site.
- Phase 2 (1996-97) - Preliminary engineering study.
- Phase 3 (1998) - Design in details, facility manufacturing, construction, and operation.

**Location**

Tiefu City, Liaoning Province

**Technical Summary**

Updated technology for a CBM recovery/utilization will be needed.

**Estimated Capital  
and O&M Costs**

APEC provided grant of US\$15 million.

**Sources of Revenue**

Gas sales to nearby cities.



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**Proponents/  
Sponsors of the  
Project**

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**CBM Exploration and Development in  
the Yangquan Coal Area**

**Contact Information**

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Shanxi Province, China  
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Fax: +86 353 7070897

**Status**

Exploration

**Location**

Yangquan City, Shanxi Province

**Technical Summary**

The project will adopt surface vertical wells in advance of mining to recover CBM. Under the project, CBM will be directly sold to the end users in the nearby cities and towns.

**Estimated Capital  
and O&M Costs**

Project plans call for drilling 184 wells. The capacity of production is about  $2 \times 10^8 \text{ m}^3/\text{a}$ . The lifetime of the project is 20 years. The stable production period is 15 years. The capital cost of the project is about US\$120 million. The operation cost during the stable production period is about US\$5.7 million.

**Sources of Revenue**

The minimum investment in the exploration period will be US\$2.4 million. China United Coalbed Methane Co. Ltd. will invest US\$1.7



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million. Both China Coal Geological Bureau and Yangquan CMA will invest US\$360 thousand.

**Proponents/  
Sponsors of the  
Project**

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**Texaco Huaibei CBM Development Project**

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Fax: +86 10 64298388  
Email: mysun@chinacbm.com

**Status**

Exploration

**Location**

Huabei, Anhui Province

**Technical Summary**

The project started in 1998. In the 1998-1999 exploration period, Texaco will drill several test wells and coal boreholes to obtain production data and then submit a feasibility report. If the project is feasible, Texaco will select an appropriate area to drill four or five production wells around an exploration well. If these wells are successful, development will follow. Finally, Texaco will drill 300 surface wells, and the total gas production is expected to reach 500 million m<sup>3</sup>. The produced gas will be supplied to household users, followed by power generators and chemical producers.

**Estimated Capital  
and O&M Costs**

The cost of a production well is ~2.6 million yuan including drilling, fracturing, and well completion and testing. The operating cost per well with a gas production of 5,000 m<sup>3</sup>/d is 88,000 yuan. The total investment will be US\$500 million for the project with



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300 surface wells and necessary surface facilities including pipelines and compressing stations, etc.

**Sources of Revenue**

Project revenues will come from gas sales to household users and industrial users as well as sales of electricity generated with coalbed methane.

**Proponents/  
Sponsors of the  
Project**

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## Xinji Coalbed Methane Project

### Contact Information

Huainan Coal & Electricity General Corporation

### Status

Operational

### Location

Huainan City, Anhui Province

### Technical Summary

The project will adopt surface wells in advance of mining.

### Estimated Capital and O&M Costs

The estimated capital cost of the project is about US\$6.7 million, of which the National Science and Technology R&D fund accounts for US\$2.5 million. Huainan Coal & Electricity General Corporation, the Coal Science Research Institute Xian's Branch, Huaibei Petroleum Geology Bureau, etc. will provide funds for the supporting project and development estimated at US\$4.2 million.

### Sources of Revenue

The project is expected to produce  $6\sim7 \times 10^6 \text{ m}^3 \text{ CBM}$  each year. The price of CBM is about US\$0.12/ $\text{m}^3$ . The output can reach US\$720-840 thousand.  $2.4\sim2.8 \times 10^4 \text{ t}$  coal can be saved every year, therefore, US\$580~670 thousand can be saved every year.

### Proponents/ Sponsors of the Project

Huainan Coal & Electricity General Corporation



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## **ARCO Project**

### **Contact Information**

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Phone: +86-10-64298880  
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Email: mysun@chinacbm.com

### **Status**

Feasibility

### **Location**

Sanjiao, North Sanjiao and Shilou, Shanxi Province

### **Technical Summary**

On 29th June 1998, Arco signed contracts with CUCBM for the exploration of CBM using surface boreholes from these three areas. The contract is based on a risk exploration and product sharing model. Development will proceed if appraisal efforts are successful, with startup possible by 2003.

### **Estimated Capital and O&M Costs**

Gross development costs of the Phase 1 appraisal program are expected to total US\$52 million.



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**Proponents/  
Sponsors of the  
Project**

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**Phillips Project**

**Contact Information**

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Phone: +86-10-64298880  
Fax: +86-10-64298388  
Email: mysun@chinacbm.com

**Status**

Feasibility

**Location**

Linxing, Shanxi Province

**Technical Summary**

On 29th June 1998, Phillips signed contracts with CUCBM for the exploration of CBM using surface boreholes from the area. The contract is based on a risk exploration and product sharing model.

**Proponents/  
Sponsors of the  
Project**

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## UN-GEF Development of CBM Resources

### Contact Information

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Department of International Cooperation  
State Coal Industrial Bureau  
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Fax: +86-10-64235838

### Status

Almost completed

### Technical Summary

In 1992, the UNDP began a five-year technical assistance project on CBM in China. Both the UNDP and the Chinese Party have contributed approximately US\$10 million to the project. Star Mining Corp. implements the study on behalf of the former Ministry of Coal Industry. One of the main achievements of the project is that it has drawn attention to and enhanced the status of CBM production with the Chinese Government.

The project has four sub-projects, which are located at Tiefu (Liaoning Province), Kailuan (Hebei Province), Van (Shaanxi Province), and Songzao (Sichuan Province). So far, the Sub-projects of Tiefu, Kailuan, and Van have been completed, while the Songzao sub-project is still in progress.

(1) Kailuan Sub-project. The sub-project was jointly implemented by Kailuan CMA and Gustavson Associates Inc. Three wells have been drilled from the surface into a coal seam prior to mining for the project. Good daily gas production has been achieved from one well



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(2000m<sup>3</sup>/d), but production has been low from the others, even though stimulation measures (fracturing) have been taken. Drilling was undertaken with a second-hand surface rig procured by the UNDP, and there have been some problems and delays caused by the requirement for imported spares. Gas produced from one of the surface wells has been injected into the town gas system nearby. The revenue of the project will come from gas sales to local users.

(2) Tiefa Sub-project. The sub-project was implemented by Tiefa CMA and REI Co. The purpose of the sub-project was to introduce gob well and long horizontal borehole drilling technologies to Chinese coal mines. Three gob wells were drilled from the surface to 40-50m above the working seam at depths of 500-600m. Additionally, three long in-mine horizontal boreholes were directionally drilled into the gob area using a downhole motor, the longest borehole extended 305m. Total gas production was 1.67 million m<sup>3</sup> from the in-mine boreholes and 3.08 million m<sup>3</sup> from the surface gob wells. Meanwhile, the methane drainage efficiency was increased by 57.2% over conventional methods (cross-measures borehole).

(3) Van Sub-project. The purpose of this sub-project was resource assessment. The sub-project was implemented by Central Coal Research Institute Van Branch. Data collection is completed for 17 mining areas and a database on national coalbed methane resources has been established. Seventeen coal seams have been completely tested and 10 more exploration wells have been drilled in 12 mining areas. Two major technology transfer training courses, each three weeks in duration, have been held in Xi'an, in 1996 and 1997, with instructions from the USA.



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(4) Songzao sub-project. The purpose of the sub-project was to drill long in-seam directional boreholes. REI Co. and Songzao CMA undertook the sub-project. Two boreholes were drilled in Shihao mine and Datong No. 1 mine. Both boreholes failed due to soft rock, gas outburst, and drill-rod bogging.

A new subcontractor, ATM Drilling Co., has begun drilling in the No. 8 seam. They have experienced problems with the contrasting hard and soft rock lithology, but managed to drill a 102 m horizontal borehole. The Songzao sub-project has also installed a set of six CBM monitoring systems which measure flow rate, pressure difference, temperature, and methane concentration.

## **Proponents/ Sponsors of the Project**

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## **Lessons Learned**

### **(1) Capital**

The investment in the UNDP project consisted of 10 million US dollars through GEF, 40 million yuan by Chinese government, and the rest raised by each enterprise that is involved in the project.

The late arrival of domestic support capital and the late delivery of foreign equipment postponed the start of the project for one year.

### **(2) Choice of Contractor**



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Contractors were chosen for the three development sub-projects by international tendering. Due to lack of related expertise and experience, few contractors can overcome technical problems in time when encountering difficult conditions during project implementation. For example, the project was delayed during the implementation of Songzao sub-project because the contractor had to be changed.

### (3) Technical Problems

Because all the technologies adopted by the UNDP project are new, Chinese technical personnel conduct operations mostly under the instruction of foreign experts. The main technical problems encountered during project implementation were as follows:

- Severe mud loss with surface well-drilling, frequent failure, and heavy maintenance with the second-hand surface drill;
- Sand removal, pump holding back, and mud loss during gob well drilling;
- Drilling rod bogging and rapid wear of drilling bit when drilling long in-mine horizontal boreholes, less experience with drilling long horizontal boreholes in soft rock, and high gas outburst coal seams.

### (4) Management of Coalbed Methane Resources

A dispute over management of coalbed methane resources occurred in the Kailuan sub-project. The focus of the dispute involved the geographic area where the coal mining license had been issued, and whether the registration and licensing procedure should be performed regarding coalbed methane exploration and development.



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**UN Deep CBM Exploration Project**

**Contact Information**

Sun Wanlu  
Northern China Bureau of Petroleum Geology  
Zhengzhou, Henan Province, China  
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Fax: 86-3718894770

**Status**

Completed

**Location**

Linxing, Shanxi Province

**Technical Summary**

The UNDP sponsored Deep CBM Exploration Project was initiated in August 1993 and completed in December 1996. The project was carried out in 3 phases. The 1st phase was geological evaluation to select target areas. The 2nd phase involved gas production experiments in selected target areas using a small-scale surface well group. The 3rd phase evaluated overall development potential and the economics of development areas.

In the first phase, eight areas were selected for initial evaluation, and four were selected for further evaluation. In the second phase, 7 surface wells were drilled in the Liulin area for trial production and achieved a satisfactory outcome. Of the 7 production wells, 6 wells had stable production of more than 1000 m<sup>3</sup>/d, and one well had a peak production of 7050 m<sup>3</sup>/d. The well also had a long stable production of 400~6000 m<sup>3</sup>/d. Computer simulation of production from the 7 wells over a 20-year period indicated that over 47 million m<sup>3</sup> of gas could be produced.



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A set of technical reports was prepared as an outcome of the project.

These include:

- (a) CBM geological evaluation and target area selection,
- (b) Production prediction and economic evaluation from the Liulin experimental area,
- (c) CBM well drilling and completion,
- (d) CBM well testing,
- (e) CBM well fracturing and stimulation,
- (f) CBM reservoir simulation, and
- (g) CBM production.

## **Estimated Capital and O&M Costs**

Total finance of the project was US\$1.7 million, of which US\$1.3 million was provided by the UNDP as a grant and US\$0.4 million was by the Chinese government (50 million yuan). The project was managed by the China International Center for Economic and Technology Exchange (CICETC) of the Ministry of Economy and Trade and executed by the Northern China Bureau of Petroleum Geology.

## **Sources of Revenue**

Economic evaluation for gas utilization as town gas, fuel for small power plants, and feedstock for activated carbon and other chemical production were carried out showing promising economic benefits.

## **Proponents/ Sponsors of the Project**

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# CZECH REPUBLIC

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### Current CBM Activities

DPB, Inc.'s Project for Coalbed Methane Development

### Key Factors in Energy Economy

- In 1993, approximately 2.4 quadrillion Btu's of energy were consumed.
- With almost no oil reserves of its own, the Czech Republic imports most of its oil from Russia. It imported a total of 150,000 barrels per day in 1993.
- In 1994, the Czech Republic consumed about 240 billion cubic feet of natural gas, mostly imported from Russia.
- Coal accounts for about 88% of the energy consumption.
- In 1993, there were approximately 6 billion short tons of coal in reserves, approximately 88.1 million short tons were produced, and 13.5 million short tons were exported.

### Potential Role of CBM in Energy Economy

CBM resources are estimated to be  $51 - 371 \times 10^9 \text{ m}^3$ , of which  $12 - 88 \times 10^9 \text{ m}^3$  are documented.

### CBM Potential

- The Czech republic seeks to meet its growing energy needs by relying more heavily on clean energy sources rather than on coal. CBM could make a substantial contribution, but CBM development there has not begun aggressively. Currently, over  $520 \text{ m}^3$  of coal mine methane are liberated by mining each year, and roughly 75 percent of that is simply vented to the atmosphere.
- The Ostrava-Karvina Coal Basin (OKR),  $1600 \text{ km}^2$  in area (400,000 acres), accounts for 99.8% of methane emissions from mines in the Czech Republic. There are 255 seams with a net coal thickness of 150 m (492 ft). The methane content of the coal is between 4.4 to  $20 \text{ m}^3/\text{t}$  (141 - 160 cuft/t). Annually, gas drainage plants produce



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about 120 million cubic meters (4.24 Bcf/y) of methane.

- CBM is being recovered from both abandoned coal mines and virgin coal seams.

## Existing Policies Affecting CBM Development

Mining Law

## Overseeing or Permitting Government Agencies

Ministry of Industry and Trade

Na Frantisku 32

110 15 Praha 1

Phone: (420 2)24 85 11 11

Fax: (420 2)24 81 10 89

Minister: Karel Kuhn

## Potential Barriers to CBM Development

- Coal production has declined sharply in the last several years because of government downsizing, and this trend is likely to continue for the foreseeable future.
- Unusual geography makes mining difficult in some areas.

## Donors/ Companies/ Investors Active in CBM

- OKD Inc, Ostrava (subsidiary - DPB Inc., Paskov)
- CMD Inc., Kladno
- GPO, Inc., Ostrava
- Unigeo, Ostrava
- Ministry of Environment
- Ministry of Economy
- Czech Gas Company

## DPB, Inc.'s Project for Coalbed Methane Development

### Contact Information

Georges Takla, Vice President  
DPB  
Phone: 420 69 626 3080  
Fax: 420 658 671 588  
Email: [Georges.Takla@pb.cz](mailto:Georges.Takla@pb.cz)

### Status

Operational

### Location

Approximately 240 km<sup>2</sup> (59,300 acres) area adjacent to Kavina, Brusperk, Frenstat, and Radhostem

### Technical Summary

- Recovering coal seam gas from abandoned mine workings and virgin coal seams
- From July 1993 - July 1994, average production was 1,100 m<sup>3</sup>/d (38,850 Mcfd) of 100% methane

### Proponents/ Sponsors of the Project

DPB



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## INDIA

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### Current CBM Activities

- Advanced Resources Inc. Estimates in Damodar Valley Basins
- India's Oil and Natural Gas Commission drilling in the Damodar Valley
- Great Eastern Energy Co. in the Raniganj coal field
- Reliance Gas Private Ltd. in eastern Raniganj basin
- GEF project
- Texaco Inc. coal seam exploration in the Cambay Basin area of Gujarat
- Mckenzie Methane

### Key Factors in Energy Economy

- India is the world's 3<sup>rd</sup> largest coal producer. More than half of India's energy requirements is supplied by domestic coal. Of that, coal supports approximately 70% of the power generation. Coal production = 311 million short tons, coal consumption = 321 million short tons, net coal imports 10 million short tons (1996).
- India ranks 5<sup>th</sup> in proven coal reserves with nearly 70 billion tons.
- Oil accounts for 30% of India's total energy consumption.

### Potential Role of CBM in Energy Economy

- Given that there are large coal resources in India, CBM could play a substantial role in future activities.
- Coalbed methane could cut India's energy deficit and surging demand for imported natural gas.

### CBM Potential

- Estimated resource base is between 30 tcf and 144 tcf.
  - (a) Estimates in the Damodar Valley range from 10 tcf to more than 114 tcf.
  - (b) Estimates in the Cambay Basin are about 11 tcf for coal seams between 2,000 and 5,000 ft deep.



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### Existing Policies Affecting CBM Development

- A *New Petroleum Tax Code* is pending approval. It offers CBM projects infrastructure status, which allow a 5-year tax holiday from the date production commences, and a 30% concession on income tax payable in the following 5 years. The government is considering whether to extend this period for an additional 2 years. This concession reduces the 48% tax rate on foreign operating companies to 33.6% during that period. No customs duties would apply. The companies will be subject to a base rate 10% *ad valorem* royalty, payable to the respective state government. An additional production-linked payment would be payable to the central government on a sliding scale based on the production level. This payment schedule has been kept as a biddable item. A nominal commercial bonus of \$300,000 would be paid on declaration of commercial assessment.
- *1997 Guidelines for the Semiprivatization of State-Run Coal Mines.* This overhaul of the country's ailing coal mining industry offers mines to state-owned and private firms for captive consumption only.

### Overseeing or Permitting Government Agencies

- Coal India Limited
- Ministry of Petroleum and Natural Gas-governmental authority for the exploitation of CBM
- Directorate General of Hydrocarbons - regulatory body responsible for preparing terms and conditions of contracts for CBM exploration and production and licensing, developing the block data packages, and maintaining oversight during the exploration and development cycle.

### Potential Barriers to

- Government controls over new investments in the coal industry.



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### CBM Development

However, guidelines for foreign investment (January 1997) for local consumption of power allow more investment by private and foreign companies in coal mining.

- India's Oil and Natural Gas Commission has conventional oil and gas operations throughout the region, complicating ownership issues.
- Institutional problems regarding resource ownership and modalities of payment to the nationalized companies.

### Donors/ Companies/ Investors Active in CBM

Essar Oil Co., U.S. Agency for International Development Program for Acceleration of Commercial Energy Research, ARCO, Phillips Petroleum Co. Texaco Inc., Reliance Gas Private Ltd., India's Oil and Natural Gas Commission, Gas Authority of India Ltd., Advanced Resources Inc, Great Eastern Energy Co., Amoco India Petroleum Co., Enron Exploration Co., Global Environment Facility



# Seminar and Roundtable on Coalbed Methane Development and Potential **INDIA PROJECT**



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## Coalbed Methane Capture and Commercial Utilization

### Contact Information

UNDP

### Status

Full Project

### Location

Jharia and Raniganj basins in the state of Bihar, India

### Technical Summary

The objectives of this project are to control greenhouse gas emissions and demonstrate the economic viability of harnessing coalbed methane, an important greenhouse gas, in the Indian coal mining sector. The full project is intended to build national capacity in the field of coalbed methane recovery and utilization.

The specific objectives are:

- Strengthen and increase institutional capacity
- Plan, engineer, and prepare for demonstration project
- Design, drill, and produce CBM
- Use the gas produced
- Develop an action plan for replication of successful activities
- Establish coalbed methane clearinghouse

### Estimated Capital and O&M Costs

- Total project cost US\$19 million
- GEF – allocation US\$9.190 million
- India government co-financing – US\$4.544 million
- Indian government (in-kind) – US\$2.321 million
- UNDP co-financing US\$1.214 million
- Revenue – US\$1.760 million



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**Sources of Revenue**

Savings enjoyed by the sample mines if the gas recovered is predominantly used for producing their own power.



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## **Coalbed Methane Drilling in Northern Gujarat**

### **Contact Information**

Essar Oil Co.

### **Status**

Pilot complete

### **Location**

Near Mehsana, Gujarat, India

### **Technical Summary**

Starting in 1993, this was the first CBM drilling program in India. Under the program, three wells were drilled. Two of the wells, LBM No. 1 and LBM No. 2 are about 10km apart. Both wells were completed and stimulated. The third well, LBM No. 3, was drilled as an offset to LBM No.1 as part of a planned five-well pilot project.

Based on data from these three CBM wells and several dozen well logs from the surrounding area, it can be shown that the three main coal seams are consistently thick and laterally persistent throughout the Mehsana CBM project area. In addition, the gas content values are in the range of 200 cu ft/ton, surprisingly high given the low rank of the coal.

### **Proponents/ Sponsors of the Project**

Program for Acceleration of Commercial Energy Research,  
U.S. Agency for International Development



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**Amoco India Petroleum Co. in the Damodar Valley**

**Contact Information**

Amoco India Petroleum Co.

**Status**

Suspended

**Location**

Damodar Valley in the states of Bihar and West Bengal

**Technical Summary**

In 1994, Amoco India Petroleum Co. was awarded a government concession for coal seam gas evaluation in virgin coal at the Ranganj, Jharia, East Bokaro, and North Karanpura coal fields. Based on rank, thickness, and limited sorption isotherm data, Amoco India estimated coal seam gas resources of 10 to 24 Tcf and recoverable gas on the order of 1.4 Tcf in the unmined coals of these fields.

**Estimated Capital  
and O&M Costs**

The project was estimated at US\$1 billion.

**Proponents/  
Sponsors of the  
Project**

Amoco India Petroleum Co.

**Lessons Learned**

In September 1996, Amoco India suspended the project because it was unable to secure a commitment from the government to fund or build a gas pipeline into the remote Damodar fields. Furthermore, a mutually satisfactory production agreement for gas sales could be realized.



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**Reliance-Texaco Inc. in the Cambay Basin**

<b>Contact Information</b>	Texaco Inc.
<b>Status</b>	Pending government approval
<b>Location</b>	Cambay basin in northern Gujarat, India
<b>Technical Summary</b>	Operators estimate the field's potential productivity at 5.7 to 14 million m <sup>3</sup> /d.
<b>Estimated Capital and O&amp;M Costs</b>	Up to US\$1 billion could be invested over the next 8 years.
<b>Proponents/ Sponsors of the Project</b>	Reliance Industries Ltd.



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## **POLAND**

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### **Current CBM Activities**

- Amoco Poland Ltd. Project in Upper Silesia
- Electrogaz Ventures Ltd. Project in Upper Silesia
- PolTex Methane-Texaco Inc. Project in Upper Silesia
- Metanel SA Project in Upper Silesia
- McCormick Poland Ltd. in Upper Silesia

### **Key Factors in Energy Economy**

- In 1994, the total energy consumption was about 3.96 quadrillion Btu: 76% coal, 15% oil, 8% natural gas, 1% hydroelectric.
- Coal is not only the dominant fuel in Poland's economy, but it is also the main source of foreign exchange earnings for the country.
- In 1995, over 98% of consumed oil and almost 60% of consumed natural gas was imported.

### **Potential Role of CBM in Energy Economy**

- Poland is 4<sup>th</sup> in the world in production of hard-coal with the total reserves of 10.2 to 15 x10<sup>10</sup> st. m<sup>3</sup> and 4 x10<sup>10</sup> st. m<sup>3</sup> recoverable, hence CBM could become an integral part of the energy economy.
- CBM could help offset some of the debt accrued by the coal industry.
- CBM could help balance the trade deficit by reducing the need to import natural gas.

### **CBM Potential**

- Poland has the potential to be the 2<sup>nd</sup> largest CBM producer in the world based on reserves in two of the three major coal basins.
- Resources estimates for the Upper Silesian coal basin range from 45.9 to 12.4 Tcf.
- Resource estimates in the Lower Silesian and Lublin basin range from 2.7 to 5.3 Tcf.



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### Existing Policies Affecting CBM Development

- *Geological and Mining Law of February 4, 1994* – regulates the ownership of, and the right to explore and extract, natural resources.
- *Energy Law* – obliges energy enterprises to supply and connect customers, meet demand, and initiate actions for reducing consumption.

### Overseeing or Permitting Government Agencies

Ministry of Natural Resources  
ul. Wawelska 52/54  
00-922 Warszawa  
Jacek Wroblewski  
Phone: 48 22 251503, 48 22 250001 int. 335  
Fax: 48 22 251503, 48 22 253972  
Email: [JWROBLEW@MOS.GOV.PL](mailto:JWROBLEW@MOS.GOV.PL)

### Potential Barriers to CBM Development

- *Lack of technology* – There is a need to expand gas storage and to improve methane drainage systems.
- *Taxes* – More favorable tax conditions could help spur coalbed methane utilization.
- *Adapting to Market Economy* – The inefficient hard coal industry is struggling to adapt to the market economy. Government controlled coal prices and “social employment” remain as serious barriers.

### Donors/ Companies/ Investors Active in CBM

AMOCO Poland Ltd., McCormick Poland Ltd., Elektrogaz Ventures Ltd., Metanel S.A. PolTex Methane, Vikelt Ltd., World Bank, U.S. Environmental Protection Agency, U.S. Agency for International Development, European Investment Bank, European Union’s PHARE Program, U.S. Trade and Development Agency



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**Amoco Poland Ltd. Project in Upper Silesia**

<b>Contact Information</b>	Amoco Poland Ltd.
<b>Status</b>	On-going production testing
<b>Location</b>	Upper Silesia Coal Basin in the states of Krakow and Katowice, Poland
<b>Technical Summary</b>	<p>In 1993, Amoco Poland was awarded a 486 km<sup>2</sup> concession, including virgin coal and four exploration concessions. The company committed to a total of 15 boreholes, at least 8 of which could be production level. Drilling operations commenced in November 1994 and concluded on November 1996. The entire program entailed drilling 25,515 meters. As of May 1997, production testing was currently on-going.</p>
<b>Estimated Capital and O&amp;M Costs</b>	Amoco Poland has committed US\$10 million to this project.
<b>Proponents/ Sponsors of the Project</b>	Amoco Poland Ltd.



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**Elektrogaz Ventures Project in Upper Silesia**

<b>Contact Information</b>	Elektrogaz Ventures
<b>Status</b>	Suspended
<b>Location</b>	Upper Silesia Coal Basin in the state of Katowice, Poland
<b>Technical Summary</b>	This tract encompasses four exploration concessions and is bordered by several mines that use some of the gas drained from their workings.
<b>Proponents/ Sponsors of the Project</b>	Electrogaz Ventures
<b>Lessons Learned</b>	The company has suspended the program because the developer claims the concession is under high environmental protection requirements by local authorities.



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**PolTex Methane-Texaco Inc. Project in Upper Silesia**

**Contact Information**

Texaco Poland

**Status**

On-going

**Location**

Upper Silesia Coal Basin in the state of Katowice, Poland

**Technical Summary**

This tract encompasses five exploration concessions. In a joint venture with McKenzie Methane Poland, PolTex drilled seven wells to depths of 1,400 to 1,850 m. Four more have reportedly been drilled. In May 1995, PolTex acquired the remaining interest from McKenzie Methane, and in March 1997, PolTex signed an agreement with Texaco Poland to acquire the rights to appraise and develop CBM.

**Estimated Capital  
and O&M Costs**

Under the agreement, Texaco has made an initial cash payment of US\$500,000 and started a substantial initial drilling program in mid-October 1997. If the program is successful, at the end of an 18-month period Texaco can elect to continue work on the concession in exchange for an additional US\$2.5 million. Texaco will then have 30 months to undertake development, and may complete the acquisition for a further US\$2.5 million payment. In addition, PolTex will receive a portion of the profits from the sale of the methane gas.

**Proponents/  
Sponsors of the  
Project**

Poltex Methane



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**Metanel SA Project in Upper Silesia**

**Contact Information**

Metanel SA

**Status**

On-going

**Location**

Upper Silesia Coal Basin in the state of Katowice, Poland

**Technical Summary**

Concesions granted to Metanel SA cover 27 km<sup>2</sup>. At the beginning of June 1994, the company spudded the first exploratory well. The test results recovered high-methane gas without any remnants of sulfur, nitrogen, or their chemical combinations. Gas will be produced from coal beds one or more meters thick in the reservoir located at a depth 510 to 1000 meters below ground level. Metanel plans to drill 70 wells and to reach a productivity of 150 million st m<sup>3</sup>.

**Proponents/  
Sponsors of the  
Project**

Metanel SA

**Lessons Learned**

A problem with salt water disposal was resolved by storing it in a sandy reservoir 1000 m below ground level.



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**McCormick Energy Project in Upper Silesia**

<b>Contact Information</b>	McCormick Energy
<b>Status</b>	Suspended
<b>Location</b>	Upper Silesia Coal Basin in the states of Krakow and Katowice, Poland
<b>Technical Summary</b>	In 1993, McCormick Poland was awarded a concession in an area of virgin exploration in the eastern part of the basin. The company signed a contract to drill nine wells on two license blocks covering 243 km <sup>2</sup> .
<b>Proponents/ Sponsors of the Project</b>	McCormick Energy



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## ***RUSSIA***

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### **Current CBM Activities**

- Reduction of CBM Emissions in the Kuznetsk Coal Basin
- Utilization of CBM in a Boiler House of the Pervomayskaya Mine

### **Key Factors in Energy Economy**

- World's largest producer of natural gas at 600 billion m<sup>3</sup>.
- World's 3rd largest producer of oil, producing 293 million tonnes of crude oil in 1996.
- World's 4th largest coal producer. In 1997, the coal mines produced 262 million tons of coal.

### **Potential Role of CBM in Energy Economy**

- CBM recovery and utilization projects are expected to promote local economic development by potentially offsetting the number of jobs lost during the restructuring and by enhancing the financial viability of coal mines.
- CBM projects may improve profitability of mines by increasing revenues or by decreasing costs.
- Russia is one of the world's largest producers of CBM.
- CBM emissions comprise ~15% of the total national anthropogenic methane emissions.

### **CBM Potential**

- A project at just 10 of the mines in the Kuznetsk coal basin could achieve annual reductions of ~4.6 million tonnes of CO<sub>2</sub> equivalent.

### **Existing Policies Affecting CBM Development**

- Federal Program to Improve Socio-Economic and Environmental Conditions of the Kemerovo Oblast
- Climate Action Plan of the Russian Federation

### **Overseeing or Permitting Government Agencies**

- Russian Committee for Environmental Protection
- Russian Federal Service for Hydrometeorology and Environmental Monitoring



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## ***RUSSIA***

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- Russian Ministry of Fuel and Energy
- The Institute of Coal & Coal Chemistry, Russian Academy of Sciences, Siberian Branch
- Russian Coalbed Methane Center

### **Potential Barriers to CBM Development**

- To be successful, the project needs input and cooperation from several main ministries, local authorities, and other institutions in Russia. The Technical Working Group (TWG) will promote cooperation.
- Lack of experience using coal mine methane.
- Political instability.
- Lack of capital.
- Lack of information available to outside investors.

### **Donors/ Companies/ Investors Active in CBM**

- Partners in Economic Reform, Partnership for Freedom, National Pollution Abatement Facility, U.S. Environmental Protection Agency, United Nations Development Programme, World Bank Global Carbon Initiative and Carbon Investment Fund, GEF, U.S. Agency for International Development



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**Reduction of CBM Emissions in the Kuznetsk Coal Basin**

**Contact Information**

Ministry of Fuels and Energy  
Dr. Oleg Tailakov, Project Manager  
21 Rukavishnikova Street, Room 208  
Kemerovo, 650625, Russia  
Phone: (7-3842) 259300  
Fax: (7-3842) 211838  
Email: [tailakov@mail.stanet.ru](mailto:tailakov@mail.stanet.ru)

**Status**

Feasibility stage estimated starting date ~April 1, 1998. Estimated duration ~10 months.

**Location**

- Kemerovskaia Oblast, Russian Federation
- Approximately 26,000 km<sup>2</sup> (10,036 mi<sup>2</sup>)

**Estimated Capital  
and O&M Costs**

US\$80,000 for salaries of staff

**Proponents/  
Sponsors of the  
Project**

UN OPS



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***RUSSIA PROJECT***

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**Utilization of CBM in a Boiler House of the Pervomayskaya Mine**

**Contact Information**

Averchenkov, Director  
National Pollution Abatement Facility  
Kedrova str. 8/1, GSP-7  
Moscow 117874 Russia  
Phone: +7 095 1255559/4314  
Fax +7 095 1255559  
Email: averchenkov@npafem.msk.ru

**Status**

NPAF Council has approved the loan

**Location**

Berezovskiy, Kemerovo region

**Technical Summary**

The mine liberates and drains 14,000 T/yr of methane. Presently none of it is being used. The project will involve conversion of boilers to fire 6,750 t/yr of CBM with coal, which will serve as a model for expanding CBM use in the Kuznetsk Coal Basin. Estimated CBM resources associated with the coal reserves of Kuzbass mines range from 194 to 342 billion m<sup>3</sup>.

There are three main components of the project:

- 1) enhanced drilling,
- 2) creation of centralized system of collection and isolated transportation of captured gas using pipelines, and
- 3) reconstruction of a boiler house to cofire coal and methane. This fuel mixture will have an average methane concentration of 40% or greater, and a potential energy equivalent of 9 Gcal/hr. The gas



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input may vary from less than 10% to up to 100% of total fuel supply, depending on boiler design and the needs of the boiler operator.

### **Estimated Capital and O&M Costs**

Capital cost: US\$1,588,000

Operation and maintenance cost: US\$89,800/year

### **Sources of Revenue**

Heat to mine

Electricity

### **Proponents/ Sponsors of the Project**

Averchenkov, Director

National Pollution Abatement Facility

Kedrova str. 8/1, GSP-7

Moscow 117874 Russia

Phone: +7 095 1255559/4314

Fax +7 095 1255559

Email: averchenkov@npafem.msk.ru

### **Lessons Learned**

The project has special importance, as it will help to solve the problem of safety at the working place. There were a few incidents in the region, which killed some people over the last months because of methane exposure. Administration of the Kuzbas region and Ministry of Fuel and Energy has greatly supported this project.



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## **Current CBM Activities**

- Springbok Flats Feasibility Study

## **Key Factors in Energy Economy**

- South Eskom, South Africa's state electric company, presently generates about 96 percent of South Africa's electricity and accounts for about half of the generation for the entire African continent. Over 90 percent of electricity generation is coal-fired.
- Almost a total lack of oil and gas reserves, its abundant coal reserves, and years of international embargoes and isolation led South Africa to build a highly developed synthetic fuels industry. In fact, of the 140,000 barrels of oil produced daily, 130,000 barrels are produced synthetically from the processing of coal to oil. South Africa consumes about 400,000 barrels of oil per day. Proven oil reserves are about 40 million barrels.
- Natural gas reserves are about 826 billion cubic feet (1996). Although natural gas production currently meets the yearly consumption of about 69.2 billion cubic feet, additional supplies will soon be needed to supply the increasing demand.
- In 1996 net coal exports were 65.9 million short tons. South Africa is the 5th largest producer of coal in the world with production at 227.5 million short tons, and consumption at 164.7 million short tons.
- Coal presently accounts for, in one way or another, the vast majority (~98 percent) of South Africa's energy production and approximately 78 percent of total energy consumption.

## **Potential Role of CBM in Energy Economy**

- South Africa contains the seventh largest coal reserves in the world (~60 billion short tons).
- Due to the large reserves (as discussed above), CBM could



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become a viable and profitable energy source for South Africa.

- CBM could forestall the future need to import natural gas.

## **CBM Potential**

- Several areas have been identified as having potential for CBM development.
- More mines are expected to open where CBM technologies could be incorporated at the same time. If these mines are not approved by government officials in response to environmental activism, Sasol (South Africa's third largest coal producer) will have to explore other ways to further expand production at its already existing room-and-pillar mines.
- Evidence of the gas potential arises from a long record of gas-related mine explosions.

## **Existing Policies Affecting CBM Development**

- Minerals Act, 1991
- Coalbed Methane is defined under law as a mineral in its own right. Therefore, two companies can have rights to a gassy seam—one for coal and one for methane.
- “Ring-fencing”

## **Overseeing or Permitting Government Agencies**

Mineral and Energy Affairs  
Department of Mineral Affairs  
Dr. Church Synodal Center, 234 Visagie Street  
Private Bag X59  
Pretoria 0001  
Phone: 012 317.9127  
Fax: 012 320.0810

## **Potential Barriers to CBM Development**

- Allocation of ownership rights has not yet been determined (except



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in the Springbok Flats Project).

- Current government subsidies are deterring foreign investment.
- Treatment of development costs which preclude the write-off “ring-fencing” of development costs against other income.
- The potential for preferential tax treatment.
- Political changes within in the country have created a situation where dramatic improvements are needed in the country’s infrastructure in order to enable it to meet the needs of all its people.
- Transition from energy self-sufficient policies to new energy policies.

## **Donors/ Companies/ Investors Active in CBM**

U.S. Trade and Development Agency, U.S. Department of Energy, Natural Buttes Gas Corporation, Advanced Resources International, Southern African Development Community, Department of Minerals and Energy Affairs



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## Springbok Flats Feasibility Study

### Contact Information

Art Baldwin, Regional Coordinator for Africa  
U.S. Department of Energy, Federal Energy Technology Center  
P.O. Box 10940  
Pittsburgh, PA 15236  
Phone: 412 892-6011

### Status

Pre-Feasibility study completed in January 1996. Feasibility study is not yet completed. Currently engaged in study and preliminary drilling.

### Location

Springbok Flats, Northeast Transvaal - rural areas of Lebowa, Venda, and Gazankula

### Technical Summary

The feasibility study includes "the geotechnical assessment of the extent of the CBM resources, determination of economic recovery including pilot production, a detailed inventory of possible natural gas markets and applicable gas pricing, and a detailed economic analysis of all aspects of the project. The study would include an environmental impact assessment that would encompass an evaluation of the benefit of natural gas substitution for coal and firewood heat energy."

### Estimated Capital and O&M Costs

The Feasibility Study Program allocated US\$338,000 for this project. Fifty percent is budgeted to the verification of gas content and reserves, 45% to production characteristics, and the balance to market research and environmental effects.

- U.S. Trade and Development Agency has provided \$137,000 for a feasibility study.



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## **Sources of Revenue**

- Could be used for gas-fired thermal power generation in off-grid areas
- Potential for recovery of potable water for household and agricultural use, which can be produced in conjunction with the CBM recovery process.

## **Proponents/ Sponsors of the Project**

- U.S. Trade and Development Agency
- U.S. Department of Energy
- Southern African Development Community
- Department of Minerals and Energy Affairs
- Advanced Resources Inc.

## **Lessons Learned**

The pre-feasibility study analysis indicated a potential methane production of 25 million st. ft<sup>3</sup> which could be absorbed by markets in the immediate vicinity. Based on these conclusions, a recommendation was made to proceed with a budgeted risk-managed exploration program to confirm the production potential through exploratory drilling and to quantify the risk potential through in-situ gas recovery parameter evaluation.



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## **TURKEY**

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### **Current CBM Activities**

Only initial investigations to assess Turkey's coalbed methane capture and utilization potential have been conducted. Turkey presently does not have economically significant CBM production. The Black Sea Coast area of Turkey has substantial hard coal and coal-related resources; substantial amounts of methane are continuously emitted from the coal mines. Recovery and use of this methane could be beneficial for everyone because of reduced future methane-related hazards to miners and improvement to the local and global environment.

### **Key Factors in Energy Economy**

Turkey has a growing demand for energy. Turkey is now dependent upon imported energy for a substantial portion of its energy needs. In particular, natural gas demand is increasing faster than the supply. The demand for natural gas used for power generation is increasing even more rapidly than overall demand. Gas will be a key factor in Turkey's future economic performance and strategic stability. Turkey needs reliable gas supply sources and would benefit by reduced imports.

### **Potential Role of CBM in Energy Economy**

CBM from the Zonguldak hard coal region could be a very significant factor in Turkey's energy economy. Development of the methane gas resources will alleviate some of the current and future shortages of energy in Turkey. The resources identified could fuel gas-fired power plants and supply feedstock to a newly created petrochemical complex. Electric power could be distributed to the power grid and targeted to existing and new industries.

### **CBM Potential**

The CBM in-place resources in two districts of the Zonguldak hard coal region are presently estimated to be at least 3 trillion cubic meters (TCM). Assessment of the CBM resources in the third, largest district is continuing.



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### **Existing Policies Affecting CBM Development**

CBM development will, of course, have to comply with applicable Turkish laws and regulations. Turkish tax laws embody incentives, which may be applicable to development of CBM resources. For example, an investment allowance, a deduction from taxable income, is 100% for priority development regions and for certain types of investment projects and expenditures. Various exemptions from customs, duties, and taxes may apply and be accessible because of the project's geographic location, business sector, and the ownership interest of a Turkish partner.

### **Overseeing or Permitting Government Agencies**

The Hard Coal Enterprise of Turkey (TTK), a state owned legal entity, has the rights for exploring and exploiting underground coal resources in its defined area near the Black Sea in Turkey. TTK divided its privileged operations area into three Districts and tendered the exploration and exploitation rights for coal bed methane. As a result of the bidding in December 1996 for Districts 1 & 2 and a 1998 transfer of District 3 rights, the Data Su Sondajlar A.S.-DanOil LLC Joint Venture has agreements granting the right to explore and exploit the coalbed methane gas resources for which TTK has the rights of exploration and exploitation.

### **Potential Barriers to CBM Development**

No policies specifically impeding CBM development have been identified. Potential barriers are the requirements for and logistics of importing equipment. Training Turkish personnel is required. Infrastructure for operations and equipment mobility must be developed as must maintenance facilities and machine shops. Power plant development will generate demand for turbines, electrical equipment, transformers, transmission lines, electronic equipment, and computerized systems.



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### **Donors/ Companies/ Investors Active in CBM**

- In Turkey, to date no donors or companies except the above-mentioned joint venture have been active in CBM.
- CBM will be a new and significant energy resource for Turkey.



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### **Coalbed Methane Capture and Commercial Utilization**

#### **Contact Information**

Kenneth I. Danneberg, Danneberg Energy Companies, DanOil L.L.C.  
621 17th Street, Suite 2100, Denver, CO 80293, USA  
Phone: 303.297.1373  
Fax: 303.297.1673  
Email: dannoil@rmi.net

#### **Status**

Research Activities, 2nd stage being planned  
Development partners being sought

#### **Location**

Black Sea Coast, Zonguldak hard coal region, Turkey. The TTK District 1 rights cover 722 square miles (1870 square kilometers). The TTK District 2 rights cover 1,006 square miles (2605 square kilometers). The TTK District 3 rights cover about 3300 square miles (8448 square kilometers). The areas evaluated to date (July 98) for in-place coalbed methane gas resources are 39 square miles (101 square kilometers) for District 1 and 63 square miles (161 square kilometers) for District 2, substantially all of which are onshore; 368 square miles (953 square kilometers) are being evaluated in District 3.

#### **Technical Summary**

The Joint Venture engaged the services of Raven Ridge Resources, Incorporated, to estimate the District 1 and 2 coalbed methane gas resources during 1997. Raven Ridge Resources estimated that the in-place coalbed methane gas resources in Districts 1 and 2 in the Westphalian coal and sandstone reservoirs exceed ninety trillion cubic feet (2.56 trillion cubic meters), most of which is estimated to be in the sandstone reservoirs. The research study for the more recently



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acquired District 3 is presently (August 98) underway.

The aggregate thickness of the Westphalian coal-bearing strata exceeds 1,000 meters. Raven Ridge Resources has not estimated resources for the Namurian coal-bearing interval that underlies the Westphalian Kozlu coal measures; numerous prospective coals and sandstones occur in the Namurian sediments. Significant coalbed methane gas resources may occur in the Namurian. Westphalian coal samples collected from actively mined areas were analyzed to determine source rock characteristics. The testing suggests that these coal samples can be classified as humic and are mature to late-mature Type II and Type III kerogen coals and are the likely source of gas condensate and minor quantities of oil.

### **Estimated Capital and O&M Costs**

Research Activities, 1st Phase: privately funded, resulting in geological estimates of very large coalbed methane gas resources.

Research Activities, 2nd Phase: \$15 - 20 million; seeking to verify the commercial feasibility of exploiting this methane gas as an energy resource. Some conventional hydrocarbon drilling has occurred in this area, but no drilling or testing for coalbed methane gas has been previously attempted in this geographic area, which has complex geology and limited infrastructure.

Development Activities: \$1 - 1.5 billion

### **Sources of Revenue**

Gas sales for distribution to new, efficient power plants and other residential and commercial customers. Initial gas production can be distributed through portable generators.



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### **Proponents/ Sponsors of the Project**

- Data su Sondajlari A.S.-DanOil L.L.C. Joint Venture, a Turkish contractual joint venture
- DanOil principals have extensive successful prior experience in United States, Canadian, and North Sea oil and gas projects.

### **Lessons Learned**

CBM's legal status in Turkey is now clarified. Many relevant Turkish laws and regulations are not officially translated into English. CBM evaluations may differ from natural gas.



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### **Current CBM Activities**

- CBM Energy
- Global Environment Facility CBM Recovery Project
- ICMG
- Eurodongas
- CBM in Lviv-Volyn Coal Basin

### **Key Factors in Energy Economy**

- 90% of oil and 80% of natural gas is imported, mostly from Russia.
- USG and G7 are supporting energy solutions that will allow the shut down of Chernobyl in 2000.
- Ukraine is one of the most inefficient users of energy. Collections for gas and electric power are poor, and much of that is in barter rather than cash.

### **Potential Role of CBM in Energy Economy**

- Significant potential to mitigate the imported gas
- Primary energy in power generation

### **CBM Potential**

- > 750 bcm
- Substantial quantities at unknown costs

### **Existing Policies Affecting CBM Development**

None developed, but the government is interested

### **Overseeing or Permitting Government Agencies**

- State Committee on Geology (for licensing)
- State Committee on Coal
- State Committee on Oil and Gas
- Local Miner's Associations
- Ministry of Environment
- Academy of Science



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### Potential Barriers to CBM Development

- No experience in licensing and technology
- Inadequate framework for private sector development
- Legislative and legal framework for investment is not complete
- High taxes
- No cash payments for energy supplied

### Donors/ Companies/ Investors Active in CBM

U.S. Environmental Protection Agency, U.S. Agency for International Development, GEF, Vuglegas, ICBMCG



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## CBM Energy

### Contact Information

Robert Cushman  
64 Yorkshire Drive, Hilton Head, South Carolina 29928  
Phone: 803 842 5668  
Fax: 803 842 5268  
Email: [cushman@digitel.net](mailto:cushman@digitel.net)

### Status

Negotiating for leases

### Location

Donetsk Coal Basin

### Technical Summary

A three-stage project to gasify and produce CBM is being planned:

- *Phase 1: Evaluation and pilot project (5 years)*

This stage is divided into three parts:

- 1) The existing geological and other data for the five license areas will be analyzed. Plans include drilling four exploratory wells to test the productivity of the sandstones and coals.
- 2) The first part will be expanded. CBM estimates partners will drill 10 vertical frac wells during the 2<sup>nd</sup> year and 20 during the 3<sup>rd</sup> year. These wells will be connected to a local gas gathering system (under construction) and to some local customers.
- 3) The partners plan to drill 40 vertical frac walls during Year 4 and 60 during Year 5 of the project.

- *Phase 2: Development (5 years)*

The partners will begin development drilling on selected



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commercially viable areas. Plans call for drilling about 60 vertical frac wells/year. In addition, about 10 gob wells/year will be drilled, and all wells will be prepared for production. The gas gathering system will be completed during this stage and connected to primary consumers and the main transmission system. At this point, all commercial production will be available for sale.

- *Phase 3:* Commercial degasification and production (at least 20 years).

The partners will continue to drill about 60 vertical frac wells/year. Ten gob wells/year will be drilled for 10 years. The number of gob wells will then decrease to 5/year for the next 5 years, with drilling to halt thereafter. Initial production of 290-483 MMcfd is targeted.

### Estimated Capital and O&M Costs

CBM Energy plans to invest US\$25-30 million during Stage 1. Total investment over the life of the project will exceed US\$350 million.

### Proponents/ Sponsors of the Project

- CBM Energy
- DonUgol
- MakeevUgol



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## **GEF Coalbed Methane Recovery Project**

### **Contact Information**

Mr. V. V. Kasyanov  
Ministry of Coal Industry, Kiev  
fax 380 44 228 2131

### **Status**

Under preparation

### **Location**

Gorskaya Mine, Lugansk Oblast

### **Technical Summary**

Demonstration project consisting of drilling wells from the surface, gas production tests and, if warranted, connection to gas pipeline for high-quality gas and on-site electricity for low-quality gas.

### **Estimated Capital and O&M Costs**

- Total capital costs: \$5.5 M
- Operating costs: \$0.5 M/a

### **Sources of Revenue**

- Pipeline gas
- Electricity

### **Proponents/ Sponsors of the Project**

Ministry of Coal Industry / Alternative Fuels Center



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**ICMG**

**Contact Information**

Edward Lasseter, Jr.  
Phone: 205 759-2046  
Fax: 205 759-2051

**Status**

Negotiating for a license



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## Eurodongas

### Location

Donetsk Coal Basin

### Technical Summary

- Drill three wells to ~1000m to find information about the potential recoverable reserves
- Ministry of Coal estimates the geological reserves at this site at approximately 200 billion cubic meters

### Estimated Capital and O&M Costs

Eurogas will fund all capital expenditures and receive a 70% revenue interest until its capital costs are repaid, after which interest will revert to 50%

### Sources of Revenue

### Proponents/ Sponsors of the Project

Eurogas  
Makyivs'ke Girs'ke Tovarystvo



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**CBM in Lviv-Volyn Coal Basin**

**Status**

Start date: August 1998

**Location**

Lviv-Volyn Coal Basin

**Technical Summary**

- Drill three CBM gas wells to depths of 400-500m
- Zahidukrgeologia estimates the geological reserves at this site at approximately 10 billion cubic meters

**Proponents/  
Sponsors of the  
Project**

- Eurodongas
- Zahidukrgeologia